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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte DANIEL J. HOFFMAN, KARL M. BROWN,
YING RUI, and JOHN PIPITONE

Appeal 2016-001696
Application 12/077,067
Technology Center 1700

Before JEFFREY B. ROBERTSON, GEORGE C. BEST, and
BRIAN D. RANGE, *Administrative Patent Judges*.

BEST, *Administrative Patent Judge*.

DECISION ON APPEAL

The Examiner finally rejected claims 1, 4–11, and 14–22 of Application 12/077,067 under 35 U.S.C. § 103(a) as obvious and also finally rejected claim 22 under 35 U.S.C. § 112, ¶ 4. Final Act. (November 28, 2014). Appellants¹ seek reversal of these rejections pursuant to 35 U.S.C. § 134(a). We have jurisdiction under 35 U.S.C. § 6.

For the reasons set forth below, we REVERSE.

¹ Applied Materials, Inc. is identified as the real party in interest. Appeal Br. 1.

BACKGROUND

The '067 Application is directed to a method for plasma enhanced physical vapor deposition (PEPVD) of metal films onto semiconductor wafers having features with sizes of 22 nm or less. Spec. ¶ 1. In particular, Appellants' claimed method is said to provide a nearly isotropic velocity distribution of neutral species and a predominantly vertical iron velocity distribution at the wafer surface. *Id.* ¶ 13.

Claim 1 is representative of the '067 Application's claims and is reproduced below from the Claims Appendix of the Appeal Brief:

1. A method of performing physical vapor deposition on a workpiece having device feature sizes of 22 nm or smaller in a reactor chamber, comprising:

providing a target comprising a metallic element and having a surface facing the workpiece, and establishing a target-to-workpiece gap less than one fifth of a diameter of said workpiece;

introducing a carrier gas into the chamber and maintaining gas pressure in the chamber above a threshold pressure at which mean free path is less than 5% of said gap;

applying RF plasma source power from a VHF generator to said target through an impedance match connected to said target to generate a capacitively coupled plasma at said target, said VHF generator having a frequency exceeding 30 MHz; and

extending said plasma across said gap to said workpiece by providing through said workpiece a first VHF ground return path at the frequency of said VHF generator.

Appeal Br. 12.

REJECTIONS

On appeal, the Examiner maintains the following rejections:

1. Claim 22 is rejected under 35 U.S.C. § 112, ¶ 4 as being of improper dependent form for failing to further limit the subject matter of the claim from which it depends. Final Act. 2–3.
2. Claims 1, 4–11, and 14–22 are rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of Brown,² Kobayashi,³ and Tonucci.⁴ Final Act. 4–10.

DISCUSSION

Rejection 1. Claim 22 of the '067 Application reads:

Claim 22: The method of Claim 1 further comprising limiting D.C. power on said target below a threshold at which deposition to a desired thickness requires on the order of 30 seconds.

Appeal Br. 16.

The Examiner rejected claim 22 pursuant to 35 U.S.C. § 112, ¶ 4.

Final Act. 2. The Examiner explained the basis for the rejection:

Claim 22 requires limiting DC power on said target below a threshold at which deposition to a desired thickness requires on the order of 30 seconds. Because the claim doesn't limit the 'desired thickness,' any thickness can be called the desired thickness and therefore any thickness obtained on the order of 30 seconds can be called the desired thickness. Because of the lack of limitation on the 'desired thickness', and because DC power can be used and the resulting thickness at 30 seconds is the

² US 2006/0073283 A1, published April 6, 2006.

³ US 5,439,574, issued August 8, 1995.

⁴ US 5,855,716, issued January 5, 1999.

‘desired thickness’, claim 22 does not further limit its parent claim.

Final Act. 3.

We reverse this rejection. Properly understood, claim 22 limits the amount of DC power supplied to the target to that which allows formation of a layer with a predetermined thickness in a time on the order of 30 seconds. Claim 22 limits the scope of claim 1 because the amount of DC power supplied to the target could be such that the formation of the layer of predetermined thickness occurs over a period of time not recited in claim 1. Depending on the proper interpretation of the limitation “requires on the order of 30 seconds”—an issue which we need not and do not address at this time—deposition of a layer of predetermined thickness need not require a time “on the order of 30 seconds” in claim 1. Thus, claim 22 further limits the scope of claim 1.

Rejection 2. The Examiner rejected claims 1, 4–11, and 14–22 as unpatentable over the combination of Brown, Kobayashi, and Tonucci.

Final Act. 4.

For the purpose of this opinion, we need only consider the limitation “establishing a target-to-workpiece gap less than one fifth of a diameter of said workpiece.” This language appears in both of the independent claims before us. *See* claims 1 and 16. In rejecting claims 1 and 16, the Examiner found that Kobayashi describes or suggests this claim limitation. *See* Final Act. 5 (claim 1), 8 (claim 16). In particular, the Examiner found that “Kobayashi discloses the use of relatively high pressure with a small target to substrate distance with relation to substrate size (col 6 lines 40–45: 205mm substrate, 60mm substrate size; col 5 line 14: several tens of mTorr

pressure; figure 6: gap to substrate ratio of 1/3-1/5).” *Id.* at 5; *see also id.* at 8.

As Appellants point out, the Examiner’s finding that Kobayashi’s Figure 6 describes the use of a gap to substrate ratio is erroneous. *See* Appeal Br. 4. In fact, Figure 6 shows the variability of the thickness of the positive layer is a function of the ratio of the target-substrate gap distance to the *target* diameter. Kobayashi col. 3, ll. 2–6. The independent claims limit the ratio of the target-substrate gap distance to the *substrate* diameter. Thus, the factual basis set forth in the Final Action is erroneous.

In the Examiner’s Answer, the Examiner reasons that this erroneous finding does not constitute reversible error because the entirety of Kobayashi’s disclosure suggests the use of a gap distance to substrate diameter ratio of approximately one fifth:

Figure 6 of Kobayashi illustrates a data line of the gap to target ratio corresponding to thickness uniformity (y-axis ‘thickness distribution percent’ inversely corresponding to thickness uniformity - a higher percent being less uniform thickness). Figure 6 of Kobayashi illustrates the data trend extending past the 1 /5 point to lower ratios for both trend lines, the Ar/N = 0/1 [dotted line] and ‘Ti’ [only - solid line] trend line increasing in thickness uniformity as the ratio is lower [moving towards the 0,0 corner of the plot]. Therefore, it would be obvious to one of ordinary skill in the art that increased thickness uniformity (the goal of Kobayashi - see Abstract and col 1 lines 16-45, discussing objectives of obtaining increased uniformity when depositing films on a substrate) can be obtained by lowering the gap ratio [*i.e., the ratio of the target-substrate gap distance to the target diameter*], as illustrated in figure 6. Therefore, although the ‘point’ at 1/5 on figure 6 may only correspond to a ‘0.29’ ratio as related to the ‘0.2’ required by the claims, figure 6 would lead one of ordinary skill in the art to obtain greater uniformity by further lowered the gap value (moving further left on the x-axis of figure 6), and therefore

obtain values below the ‘0.29’ value, including a ‘0.2’ value as required by the instant claims.

Answer 10–11 (*italicized text added*).

The Examiner’s reasoning is not supported by sufficient rational underpinnings. Although the Examiner correctly points out that, for some materials, Kobayashi’s Figure 6 suggest the use of a target-substrate gap distance to target diameter ratio that is less than one fifth, the Examiner does not explain why a person having ordinary skill in the art would have chosen to decrease the value of that ratio by decreasing the gap distance rather than increasing target size as disclosed in Kobayashi. In the absence of such an explanation, we cannot affirm the Examiner’s rejection. *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[R]jections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”).

We, therefore, reverse the Rejection of claims 1, 4–11, and 14–22.

CONCLUSION

For the reasons set forth above, we reverse the § 112, ¶ 4 rejection of claim 22. We also reverse the rejection of claims 1, 4–11, and 14–22 under § 103.

REVERSED